

**Richard W. Hamming**



# **Learning to Learn**

The Art of Doing Science and Engineering

## **Session 30: You and Your Research**



# You and Your Research

**“Yes, I would like to do first class work. If Hamming could, then why not me?”**

- I will start psychologically rather than logically. The major objection cited by people against striving to do great things is the belief that it is all a matter of luck.
- (1) it is worth trying to accomplish the goals you set yourself.
- (2) that is worth setting yourself high goals.



# You and Your Research

## **“Luck favors the prepared mind” (Louis Pasteur).**

- You prepare yourself to succeed, or not, as you choose, from moment to moment, by the way you live your life.
- Shannon’s Master Thesis was applying Boolean Algebra to switching circuits! When Einstein was 12-14 years old he asked himself what light would look like if he went at the velocity of light.
- Both of them prepared themselves long ago, but that early question, to understand better than the others what was going and how to approach to it.



# You and Your Research

**“Genius was 99% perspiration and 1% inspiration” (Edison).**

- It is hard work, applied for long years, that leads to the creative act, and it is rarely just handed to you without any serious effort on your part.
- One of the characteristics that you see is that great people when young were generally active
- Brains are nice to have, but many people who seem not to have great IQ's have done great things.



# You and Your Research

**“A prophet is without honor in his own country”  
(Old saying).**

- Mohammed fled from his own city to a nearby one and there got his first real recognition!
- Einstein was not a great student, and many other great people were not at the top of their class.
- Ability comes in many forms, and on the surface the variety is great; below the surface there are many common elements.



# You and Your Research

**“If what you are working on is not important and not likely to lead to important things, than why are you working on it?”**

- If you do not work on important problems then it is obvious that you have little chance of doing important things.
- Einstein was not a great student, and many other great people were not at the top of their class.
- Ability comes in many forms, and on the surface the variety is great; below the surface there are many common elements.



# You and Your Research

**“Courage, or confidence is a property to develop in yourself”.**

- The courage to continue is essential since great research often has long periods with no success and many discouragements.
- The desire for excellence is an essential feature for doing great work. Without such a goal you will tend to wander like a drunken sailor.
- As noted before, Lecture 1, the difference between having a vision and not having a vision, is almost everything, and doing excellent work provides a goal that is steady in this world of constant change.



# You and Your Research

**“Age is a factor that physicists and mathematicians worry about”.**

- It is easily observed that the greatest work of a theoretical physicist, mathematician, or astrophysicist, is generally done very early.
- But in literature, music composition, and politics, age seems to be an asset. The best compositions of a composer are usually late ones, as judged by popular opinion.



# You and Your Research

**Thus what you consider to be good working conditions may not be good for you!**

- There are many illustrations of this point. For example, working with one's door closed lets you get more work done per year than if you had an open door.
- But I have observed repeatedly that later those with closed doors, while working just as hard as others, seem to work on slightly the wrong problems, while those who have let their door stay open get less work done but tend to work on the right problems!
- Open mind leads to the open door, and the open door tends to lead to the open mind, that they reinforce each other.



# You and Your Research

**Intellectual investment is like compound interest, the more you do the more you learn how to do, so the more you can do, etc.**

- It must be well over 6% - one extra hour per day over a lifetime will much more than double the total output.
- But be careful – the race is not to the one who works hardest!

**You need to work on the right problem at the right time and in the right way – what I have been “style”.**



# You and Your Research

**Great people can tolerate ambiguity, they can both believe and disbelieve at the same time.**

- You must be able to believe that your organization and field of research is the best that there is, but also that there is much room for improvement!

**“It ain’t what you do it’s the way that you do it.”**

- Do your job in such a fashion that others can build on top of it.

**It is a poor workman who blames his tools.**

- I have always tried to adopt the philosophy that I will do the best I can in the given circumstances, and after it is all over maybe I will try to see that things are better next time.



# You and Your Research

**I must come to the topic of “selling” new ideas. You must master three things, (Lecture 5) :**

1. Giving formal presentations
2. Providing written reports
3. Master the art of informal presentations as they happen to occur.

**All three are essential - you must learn to sell your ideas, not by propaganda, but by force of clear presentation.**



# You and Your Research

**Change does not mean progress, but progress requires change.**

- To master the presentation of ideas, while books on the topic may be partly useful, I strongly suggest that you adopt the habit of privately critiquing all presentations you attend and also asking the opinions of others.
- Try to find those parts that you think are effective and which also can be adapted to your style.
- Certainly a good after dinner speech requires three well told jokes, one at the beginning, one in the middle to wake them up again, and the best one at the end so that they will remember at least one thing you said!



# You and Your Research

## **“The unexamined life is not worth living”.**

- The essence of these lectures is “style”, and there is no real content in the form of the topics like coding theory, filter theory, or simulation that were used for examples.
- The content of these lectures is “style” of thinking, which I have tried exhibit in many forms.
- In a sense, this has been a course that a revivalist preacher might have given – repent you idle ways and in the future strive for greatness as you see it. I claim that it is generally easier to succeed than it at first seems!
- GOOD LUCK!